

Study on Elemental Composition and Dissolution Characteristics of Trace Elements from Synthesized Zeolite from Coal Ash

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1. Background and Research Objectives

Recently, coal ash is an important issue for electric and steel companies due to its massive production. Therefore, these companies used coal ash to produce synthesized zeolite which is effective to neutralize soil pH and improve CEC in agricultural acid soil. Coal ashes usually contain six specific elements (As, Cd, Cr(VI), Cu, Pb and Se), which are strictly regulated in terms of their concentrations and dissolution by the Japanese Environmental Agency Notification No.46 (No.46). However, the above-mentioned properties of synthesized zeolite are still unknown. Such elements in the zeolite are thought to progressively dissolve on the reaction with acids and, therefore the dissolution characteristics might be changed due to the grain size and acid concentrations. The main objectives of the present study are, to discuss about the utilization of zeolite in agriculture by assessing the elemental composition of synthesized zeolites in Japan, and to clarify the dissolution characteristics of trace elements present in zeolite with special reference to grain size of the samples.

2. Materials and Methods

In the present study, eight commercial zeolites (Ca and Fe/powdery and granulated samples) were used which represents 50 % of total productions in Japan in 2005. The total elemental composition of the samples was determined using hydrofluoric acids. At the same time, the concentrations of the six elements were also determined using the No. 46. Dissolution characteristics of trace elements from Ca-type zeolite (both powdery and granular) were analyzed by different concentration of H₂SO₄ based on the size of the grain of the samples.

3. Results and Discussion

(1) Elemental composition of synthesized zeolite

The elemental composition is similar to the composition in coal ashes except Cd and Cr. There is no significant composition difference between Ca-type and Fe-type zeolites. In case of powdery sample, the amount of As, Pb and Se are larger with larger grain size. However, there is no difference in granulated samples due to grain size.

(2) Dissolution experiments

According to No. 46, the six elements were below the critical values in all samples, when considering practical uses. Concentrations of As, Pb and Se were higher with lower pH in powdery and granulated samples and concentrations changes rapidly around 4.5 pH condition. Both samples showed higher concentration in fine grain.

(3) Using the zeolite in agriculture

From this study, I propose utilization of zeolite in agriculture by sieving smaller grain size than 53-250 μm which contains the largest amount of As, Pb and Se for reducing the risk about pollution in underground water and soil by As, Pb and Se dissolution. Therefore, I also propose use of zeolite for improving CEC and physical condition where soil has pH higher than 4.5 and no anaerobic condition like a paddy field.